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INSTITUTE OF GAS TECHNOLOGY
AFFILIATED WITH ILLINOIS INSTITUTE OF TECHNOLOGY
CHICAGO 16, ILLINOIS

GAS ABSTRACTS

VOLUME 4
NUMBER 8

AUGUST
1948

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GAS ABSTRACTS is published and distributed monthly by the Institute of Gas Technology, Chicago 16, Illinois. The contents of selected papers and patents are reviewed impartially by the editorial staff and material of potential interest to the Gas Industry is presented. Subscription rates to non-members of the Institute: $15.00 per year. — Printed in the U.S.A.

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1. GAS INDUSTRY

British Gas Industry

Finlayson, T. C. and Townend, F. S. GAS PRODUCTION IN PERSPECTIVE. *Gas J.* (British) 254, 683-686, 689-696, 701 (1948) *June* 16; *Gas Times* (British) 55, 360,361 (1948) *June* 18.

A statistical and technical summary is given of developments in the British gas industry during the past 140 years in which consideration is given to coal supply, types of gas making plants, fuel economy, flexibility of output and means of controlling the coke to gas ratio. Future possibilities for gas production seem to depend on (1) practical experience with bituminous coal, and (2) use of oxygen and pressure.

C. Von Fredersdorff

Cost Data

Carlson, H. and Fitz, O. D. COSTS AND PRICES—A PARAMOUNT GAS INDUSTRY CHALLENGE. *Gas Age* 101, 40-41, 72, 74 (1948) *April* 29.

The wholesale price of all commodities, combined, rose 97% in the years 1939-1947, while that of gas moved up a scant 1%. During this time, the prices of the gas industry's three more important purchases were exerting extremely strong upward pressure on the cost of manufacturing gas: the price of bituminous coal advanced 62%; that of petroleum, 73%; that of iron and steel, 39%. The latter part of 1947 and the first few months of 1948 have brought striking increases over the average for last year. Other factors adversely affecting the cost of manufacturing gas include: high-climbing wage costs, up some 88%, on the average over those in 1939; almost doubled costs of gas-plant construction; and labor strikes in the coal mining industry, which have caused the loss of over one million man-days, 550,000,000 tons of coal, or one full year of production in the last 20 years. The article presents interesting statistics on raw material costs and the percentages of cost rises over the last decade, both in tabular and graphical form.

J. C. Lane

Customer Load Characteristic Study

REPORT ON CUSTOMER LOAD CHARACTERISTIC STUDY. Am. Gas Assoc. Rate Committee Report (1948).

The need for customer load characteristic studies is pointed out and recommendations have been made concerning the following characteristics: essential data, selection of customers, demand recorders, testing procedure, analysis and use of data.

E. F. Davis

Fire Protection

FIRE PROTECTION — (1) PREVENTION, (2) CONTROL, AND (3) EXTINGUISHMENT. *Butane Propane News* 10, 143-162 (1948) *June.*

The subject of fire protection is treated from a three-fold standpoint; namely, prevention, control, and extinguishment. Emphasis is placed on liquefied petroleum fires. An excellent description and a chart are given for fuel characteristics, including manufactured gas, natural gas and several others.

E. M. Rueck

Gas-Processing Plants

Duff, D. M. DAILY CAPACITY OF GULF COAST'S 73 GAS PROCESSING PLANTS MORE THAN 4½ MILLION GALLONS. *Oil and Gas J.* 47, 156-159 (1948) *June* 24.

The 73 gas-processing plants located on the Gulf Coast have a rated gas input of approximately 4,120 MMcf per day and produce some 110,000 bbls of liquid hydrocarbons daily, more than one-fifth of the national total for such plants. The average liquid recovery for Gulf Coast plants in Texas is about 1.1 gal per Mcf of gas, while that of those in Louisiana runs considerably higher at 1.8 gal per Mcf. Sixteen new projects will add about 675 MMcf to the input capacity of Gulf Coast plants. Present and planned or building Gulf Coast gas-processing plants are listed with their respective capacities.

J. C. Lane

Natural Gas Act

Dougherty, W. A. 10 YEARS UNDER THE NATURAL GAS ACT. *Oil Gas J.* 47, 94, 97, 99 (1948) *July* 15.

See *Gas Abstracts* 4, 120 (1948) *July* for abstract.

Pipe Lines

40,000 MILES OF NEW PIPE LINES ARE PLANNED OR UNDERWAY. *Pipe Line News* 20, 4-6, 25 (1948) *July.*

Pipe laying under way in the spring of 1948 totaled 10,000 miles, including 5,400 miles in the United States and 4,800 miles in foreign countries. According to recent announcements, almost 40,000 miles of pipe line will be laid during the next few years. Natural gas lines planned for the future total some 17,950 miles. Of the 4,238,786 tons of steel pipe which will be required during the 18-month period beginning April 1, 1948, about 3,617,680 tons will be used in the United States, 2,122,400 for natural gas lines and 1,495,283 for petroleum lines. Some of the more important pipe line projects planned, under way, or recently completed are listed in the article.

J. C. Lane

Synthetic Fuels

SYNTHETIC FUELS. *Chem. Eng.* 55, 131-138 (1948) *June.*

The activities of the government, oil and coal companies and process development organizations in the field of synthetic fuels are reviewed.

C. H. Riesz

Synthetic Fuels from Coal

Howard, F. A. CONVERSION OF COAL TO OIL AND GAS. *Mining & Metallurgy* 29, 388-395 (1948) *July.*

The trend toward the use of gas and oil as sources of energy has been dominant in the last decade. Thus, exclusive of gasoline, slightly over 60% of the Btu equivalent was supplied in 1945 in the form of coal, compared with nearly 70% in 1936. Development of oil from coal processes in relation to economic conditions are reviewed up to the present. Other than serving as a guide for future developments from coal, the conversion of natural gas to gasoline is wasteful of this resource since 40% of the available heat is lost in the conversion. Conversion of coal to gasoline is estimated to cost 12¢ per gal at current commodity and construction costs without return on the investment. With investment cost at $7000 per bbl of gasoline per day, this gasoline price increases approximately ½¢ per gal par each 1% of return of total investment before taxes. Discussion by Bruce K. Brown emphasizes that civilians would not be allowed to use two million

bbls of oil for non-military purposes in time of war. E. V. Murphree remarks that oil shale and tar sands are possible sources of oil and that investment costs of oil from coal plant is estimated to be $8000 to 10,000 per bbl per day making the price of gasoline 12¢ to 16¢ per gal on a no-return basis.

C. H. Riesz

The following article, which has not been abstracted, is called to your attention:

Marsh, F. A. MORE PIPE IN PROSPECT BUT DEMAND STAYS HIGH. *World Oil* 128, 51-52 (1948) *June.*

2. APPLIANCES

Broiler Design

RESEARCH IN BROILER DESIGN. Am. Gas Assoc. Testing Laboratories Research Bull. 48, 1948.

Data are presented indicating the effect on broiler preheating time and gas input, maintaining gas rate, excess air concentrations in flue gases and broiler heat distribution of variations in aeration of burner flames, venting of flue gases and placement of burner with respect to top of the broiler compartment. An equation is developed for correlating various broiler design features and their resultant effect on broiler performance with burners of various designs operated at an adjustment rate of 14,000 Btu per hour. The effect of volatile products formed during broiling of food on venting of flue gases is also discussed. Variations in mass, width and angle of placement of clay radiants used in conjunction with a broiler burner and their effects on broiler preheating time, preheating gas input, maintaining gas rate and heat distribution are discussed and are compared with performance when employing nichrome wire and solid metal radiants. The effect of variations in design of contemporary broilers and broiler burners, with and without radiants, on broiler performance is also noted. All results reported are based upon studies conducted with natural gas in separate high broilers. A method employing asbestos sheets impregnated with iodine solution is described for evaluating broiler heat distribution at the end of a ten-minute preheating period. This method was developed as a possible substitute for the toast test commonly employed for this purpose. Attempts made to evaluate quality of cooked products by microscopically examining meat sections before and after broiling are described in an effort to stimulate original thinking on possible solutions for this problem of evaluating broiled products and determining the extent to which they are cooked on a more exact basis.

Editor's abstract

Gas Oven Performance

RESEARCH IN FUNDAMENTALS OF DESIGN FEATURES AFFECTING OVEN PERFORMANCE. Am. Gas Assoc. Testing Laboratories Research Bull. 47, 1948.

Data obtained indicate that a previously developed fundamental equation, defining excess air in terms of flue height, input rate, and flue outlet area, may be used by gas range design engineers as a rough approximation for predicting gas oven performance with respect to excess air, preheating input and maintaining rate. This index of the oven's performance may be improved by consideration of the type of burner design, burner location with respect to the oven bottom and secondary air openings, and the nature of the flow path of the flue products from the combustion zone into the oven. Influence of these factors on excess air and preheating and maintaining rates are discussed. An improved formula is developed for computing excess air with greater accuracy than is obtainable with the original equation.

Studies conducted with six differently designed burners illustrate the effects of oven design factors on the distribution of heat in domestic gas range ovens. Oven design factors included are secondary air openings, flue size and height, distance of burner ports from oven bottom, primary aeration, and directional baffling of secondary air.

Editor's abstract

LP-Gas Installations

INSTALLATION. *Butane Propane News* **10**, 119-142 (1948) *June.*

This paper is devoted to a detailed discussion of the proper methods for installing LP-gas distribution and storage facilities. Above ground and underground cylinder storage systems for domestic, industrial, commercial and agricultural applications are covered thoroughly. Other details as yard lines, house piping, town plants and service stations are also discussed.

E. F. Davis

Panel Heating

Carroll, J. R., Jr. RADIATION AND TOTAL HEAT TRANSFER IN PANEL HEATING. *Heating & Ventilating* **45**, 62-66 (1948) *July.*

In panel heating, the floor, wall, or ceiling is a heat source just as in a conventional system a radiator is the heat source. This heat must be transferred to the air in the room, to the surroundings of the room, and to the occupants of the room, and is accomplished by conduction, convection, and radiation. In this article is presented a discussion of radiant heat transfer.

Author's abstract

Solar Radiation

Leopold, C. S. THE MECHANISM OF HEAT TRANSFER PANEL COOLING HEAT STORAGE—II SOLAR RADIATION. *Refrig. Eng.* **55**, 571-577, 608, 610 (1948) *June.*

Tests were conducted in a small scale model room to determine the effect of solar radiation on heat transfer, panel cooling and heat storage. Shading devices such as window panes, venetian blinds, and ceiling paint were varied to determine their effect on the factors studied. In general it was found that there could be considerable tolerance in window arrangement and shading devices with small variations in the maintained temperatures.

E. F. Davis

3. COMBUSTION AND INDUSTRIAL FURNACES

Air Entrainment in Burners

Von Elbe, G. and Grumer, J. AIR ENTRAINMENT IN GAS BURNERS. *Ind. Eng. Chem.* **40**, 1123-1129 (1948) *June.*

Air entrainment in burners with cylindrical tubes can be calculated on the basis that part of the stream momentum is transformed into static pressure corresponding to the flow resistance imposed by friction, buoyancy, and flame thrust. Satisfactory agreement is found with experimental data. When the flame is to be distributed over a number of port openings, Venturi ducts are required. The energy loss in a Venturi duct has been studied by separately measuring the potential energy, the kinetic energy corresponding to average velocity, and the kinetic energy contributed by the velocity profile. It has been concluded that between the Venturi throat and the burner head, the latter contribution is lost in the form of eddy motions.

Authors' abstract

Burning Pulverized Coal

Dornbrook, F. L. DEVELOPMENTS IN BURNING PULVERIZED COAL. *Combustion* 19, 32-36 (1948) *June.*

Investigation on the behavior of pulverized coal when fired in furnaces showed that (1) a coal fineness of 60-65% passing 200 mesh was practically as efficient as the standard 80-85% minus 200 mesh fineness, and (2) a moisture reduction to 1% was not necessary, as even undried coal could be burned efficiently. Some of the early problems such as uneven delivery of pulverized coal to the burners and erosion of screw feeder, burning off of burner tips, drying coal and maintaining mill capacities, and slag formation have been overcome respectively by the use of star displacement feeders, heavier construction, admission of cooling air around the burners, incorporating simultaneous drying of coal in the mills by the use of hot flue gases, the use of tangential burners and completely water cooled furnaces. Other features of design of several commercial installations are included.

C. Von Fredersdorff

Gas Turbine Power Plant

Yellott, J. I. THE GAS TURBINE POWER PLANT—VIII. *Power Generation* 52, 94-97 (1948) *February.*

This is the last of a series of articles describing several arrangements of the gas turbine compressor, combustor, heat exchanger and turbine so as to produce desired ratios of power to heat or heat to refrigeration. Approximate calculations for various conditions of power and heat production, comparable advantages in industrial applications and schematic diagrams are presented.

C. Von Fredersdorff

Industrial Gas Heating

Case, S. L., Jackson, L. R. and Lund, R. J. INDUCTION HEATING IN RELATION TO INDUSTRIAL GAS HEATING. Report by Battelle Memorial Institute to Am. Gas Assoc. Committee on Industrial and Commercial Gas Research March, 1948.

An investigation was conducted to determine the future market of high-speed gas heating in relation to induction heating in the steel industry. It is expected that sales of induction heating equipment will increase in the future. The particular market in which induction heating excels is in the hot working or forging of steel. On the other hand gas heating equipment can be purchased for nearly half the cost of induction heating equipment and can be made more versatile.

E. F. Davis

Locomotive Gas-Turbine Power Plant

Howard, A. DESIGN FEATURES OF A 4800-HP LOCOMOTIVE GAS-TURBINE POWER PLANT. *Mech. Eng.* 70, 301-306 (1948) *April.*

Features of the design are a straight-through in-line arrangement of compressor, combustion chambers, and two stage turbine resulting in minimum pressure loss; a 15-stage axial-flow compressor pump delivering 70,000 cfm at a 6 to 1 pressure ratio; and six all-metal combustion chambers burning bunker C fuel. Designed primarily for locomotive application, it is believed this unit will find other uses such as, for industrial power, automatic peak load, oil fields and pipelines, and possibly pulverized coal burning plants. Details of compressor, combustion system, turbine, and accessories are presented.

C. Von Fredersdorff

Natural Gas for Boilers

Atwater, H. A. FIRING BOILER WITH NATURAL GAS. *Gas* 24, 49-52 (1948) *June.*

This discussion is given to luminous and nonluminous flame combustion of natural gas in boilers. Such factors as mixing of gas and air, heat transfer and boiler condition are shown to have bearing on the combustion process. An effort is made to correct the idea that luminous flame combustion is not a complete combustion process.

E. F. Davis

4. CARBONIZATION AND GASIFICATION

Catalytic Cracking Process

Horsfield, S. W. THE CATALYTIC CRACKING PROCESS AS A MEANS OF PEAK LOAD SHAVING. Paper presented at the 1948 A.G.A. Joint Production and Chemical Committee Conference at Asbury Park, New Jersey, May 24-26, 1948.

The first full scale catalytic cracking process in the gas industry has been placed in operation at Riverhead, New York, by the Long Island Lighting Company. The plant can be operated to produce 100% replacement gas which matches the standard 520 Btu/cu ft heating value and 0.70 specific gravity distributed by the company. By a change in process variables, the capacity of the plant was increased approximately 45% to yield a 520 Btu, 0.80 gravity gas which is still 100% interchangeable with the normal sendout gas. With slight modifications in cooler design, an additional 10 to 15% greater capacity is expected. The operation, operating results and description of the plant and its integration in the distribution system are presented in detail. The plant is an engineering development of the Surface Combustion Corporation. The operating results are in good agreement with pilot plant and laboratory studies made by the Institute of Gas Technology as a part of the American Gas Association Gas Production Research Committee program.

C. H. Riesz

Coal Composition

Ward, S. G. COAL—CONSTITUTION AND UTILIZATION — PART II — METHODS OF UTILIZING AND PROCESSING COAL. *Gas Times* (British) 14, 168-170 (1948) *January* 30.

Due to incomplete knowledge of its basic structure, coal is still used empirically in the various processes concerned which are broadly classified as (a) direct use as fuel, (b) conversion to other more desirable fuels, and (c) conversion to organic chemicals. Group (b) includes procedures such as (1) low- and high-temperature distillation in retorts and ovens, (2) complete gasification by air-steam mixtures in producers, by air and steam alternately in water gas sets and by means of oxygen in the Lurgi process, (3) hydrogenation to produce liquid fuels and by-product hydrocarbon gases, and (4) solvent extraction under heat and pressure to produce a high volatile material which can be carbonized to an extremely low-ash coke. Group (c) includes methods for (1) preparation of hydrogen and carbon monoxide mixtures or synthesis gas and subsequent application of the Fischer Tropsch process to produce gaseous, liquid and solid paraffinic hydrocarbons, (2) separation of the constituents of coal tar, (3) chemical utilization of coal gas to obtain primarily unsaturated hydrocarbons, and (4) direct utilization of coal either by oxidation or treatment with acid to produce organic acids, aldehydes, alcohols and dyes.

C. Von Fredersdorff

Coals for Gas Manufacture

Rose, H. J. AVAILABILITY OF COALS FOR GAS MANUFACTURE. Paper presented at the 1948 A.G.A. Joint Production and Chemical Committee Conference, Asbury Park, N.J., May 24-26, 1948.

Consumption of the various high-, medium-, and low volatile coals is classified and summarized and specifications included. Existing estimates of coal reserves indicate that there are some two thousand years' supply of high volatile bituminous coal and lignite (based on present rate of consumption and loss). Twenty seven leading producers of commercial gas and coking coal are of the general opinion that adequate supplies of acceptable quality will be available for many years. The practice of washing and drying special-purpose coals is becoming increasingly popular. Trends which will probably broaden the supply of acceptable coals are (1) increased use of high and medium volatile coals and (2) development of new gasification and gas purification processes. It is expected that the finest grade commercial coals will continue to be available to the gas-utility industry, since less than 2% of the coal mined is consumed by this group.

C. Von Fredersdorff

Coking Pressure Tests

Naugle, B. W., Davis, J. D., McCartney, J. T. and Wilson, J. E. MEASUREMENT OF COKING PRESSURE IN A SMALL LABORATORY OVEN. U.S. Bureau Mines Report of Investigations 4285 (1948) May.

Results of tests on coking pressures developed in an experimental electrically heated oven measuring 12 in. long by 5 in. wide and constructed of firebrick and silicon carbide heating plates seem to indicate that (1) reduction of a coke oven to laboratory size tends to produce a higher wall pressure due partly to a greater gas pressure; (2) the magnitude of the pressure depends among other factors on rate of rise of center temperature, thickness of coke from the oven wall to the plastic layer, amount of coal which is plastic at any given time, and amount of vertical expansion; and (3) since the relationships obtained are empirical, considerable difficulty would be encountered in applying small scale results to commercial size ovens. Probable reasons for the disagreement of duplicate tests and non-duplication of small scale oven and large oven tests are summarized.

C. Von Fredersdorff

Distribution

Holtam, A. G. A METHOD OF REMOVING DUST FROM GAS MAINS. *Gas World* (British) 128, 1047-1048 (1948) *June* 26.

Deposits are effectively and efficiently removed from gas mains by the use of a rotating scraper fixed to a segmented flexible rod and pushed through the pipe by a suitable thrusting and rotating machine.

C. Von Fredersdorff

Gas Producer

Galusha, A. L. GAS PRODUCER. U. S. 2,440,940 (1948) *May* 8.

Fourteen claims are granted for an apparatus comprising gas producers and associated equipment, the principal objective of which is to provide relatively clean producer gas at a low temperature and an improved means of feeding and distributing the coal to the producer fire bed.

C. Von Fredersdorff

Gas Purification

Cooper, C. and Henshaw, D. M. PURIFICATION AND BY-PRODUCT RECOVERY—A REVIEW. *Gas J.* (British) **254**, 672-674, 679-683 (1948) *June* 16; *Gas Times* (British) **55**, 361-362 (1948) *June* 18.

The techniques and economics of present day by-product recovery in the British gas industry are reviewed. Included are comments on the paper by men representing several gas companies in regard to the various processes referred to and the new advances in the field of purification and by-product recovery.

H. Hakewill

Pexton, S., Dougill, G. and Ravald, L. A. REMOVAL OF TAR, NAPHTHALENE AND AMMONIA FROM GAS. *Gas J.* (British) **254**, 539-540, 542-544 (1948) *June* 9.

The treatment of crude coal gas prior to hydrogen sulfide removal is described; and the problems associated with condensation, tar and naphthalene removal, and the recovery of ammoniacal liquor are discussed. Modern plant practice is illustrated and schemes for modernizing older installations are outlined. A procedure for the determination of naphthalene in crude coal tar and similar products is appended to the article.

H. Hakewill

Gas Turbine Process for Gas Manufacture

Jenny, F. J. PRODUCTION OF MANUFACTURED GAS USING GAS TURBINE CYCLES. *Chem. Eng.* **55**, 108-111 (1948) *April.*

A gas turbine process generating its own compressor power for air and oxygen is outlined for the continuous production of manufactured gas from solid and liquid fuels. Gases having a calorific range from 300 to 1000 Btu/cu ft are possible by such means as oil carburetion and enrichment with hydrocarbon gases. It is shown that the high Btu gases can be compressed to pipeline pressures without destroying the power balance of the apparatus. Straight manufactured gas, pipeline gas and peak load gas are considered.

C. Von Fredersdorff

High BTU Gas Manufacture

Stephens, J. P. EQUIPMENT AND PROCESSES FOR MANUFACTURING HIGHER BTU GASES. *Am. Gas J.* **169**, 15-16, 18 (1948) *July.*

See *Gas Abstracts* **4**, 123 (1948) *July* for abstract.

Mechanical Producers

Walker, R. APPLICATION OF MECHANICAL PRODUCERS TO RETORT HOUSE PRACTICE. *Gas World* (British) **28**, 557-563 (1948) *April* 10.

Although requiring a greater capital investment, considerable attention is given to the replacement of ordinary step grate producers by mechanical producers due to their demonstrated advantages, namely (1) greater flexibility, (2) more consistent producer gas composition, (3) less loss of carbon in cinders, (4) longer operating life, and (5) improvement in working conditions. It seems justifiable to use mechanical producers in conjunction with vertical retorts as well as with horizontal installations. Further consideration is given to various types of mechanical producers such as the Trefois, power gas producer and West's producer.

C. Von Fredersdorff

Oxidation of Coal

Eddinger, R. T. and Demorest, D. J. THE OXIDATION OF COAL BY ELECTROLYSIS. *Fuel* (British) 26, 157-159 (1947) *November-December.*

Tests are reported on the oxidation of coal to humic acids in the presence of sodium hydroxide solutions by means of an electrolytic cell consisting of a graphite anode, copper cathode and a canvas permeable membrane. Vanadium pentoxide and cobalt chloride as catalyst, when added to the electrolyte, resulted in a maximum increase in humic acids. Further investigations are recommended.

C. Von Fredersdorff

Oxygen in Gas Manufacture

Newman, L. L. REPORT OF SUBCOMMITTEE ON USE OF OXYGEN IN GAS MANUFACTURE. Paper presented at American Gas Association, Technical Section, Joint Production & Chemical Committee Conference, Asbury Park, New Jersey, May 26, 1948.

Important topics considered by the subcommittee are (1) presentation of data on actual operation of large-scale oxygen-producing pilot plants and (2) obtaining results of gasification tests (using oxygen) and kinetics of carbon-oxygen-steam reactions. Oxygen gasification test results were not yet available. Kinetics of carbon-oxygen-steam reactions are at present being studied at the Institute of Gas Technology. H. S. Graham reports data on carbon-carbon dioxide-steam reactions and shows that (1) chemical rather than diffusional resistance is controlling for the carbon-carbon dioxide and carbon-steam reactions and (2) for the carbon-oxygen reaction chemical resistance is controlling at high temperature whereas diffusion controls at low temperature levels. Further consideration is given to the order of the various reactions and fuel reactivities. Rapid progress in the design and construction of tonnage oxygen plants is reported by principal firms concerned, namely; Air Products Inc., Air Reduction Co., Elliott Co., Foster Wheeler Co., M. W. Kellogg Co., Linde Air Products Co., and Stacey Dresser Co. Developments to date indicate the feasibility of both high pressure plants incorporating either regenerative, recuperative or reversing heat exchangers and atmospheric pressure plants operating entirely by distillation and incorporating either regenerative or recuperative heat exchange.

C. Von Fredersdorff

Purging Gas-Holder

Jones, S. USE OF SOLID CO_2 IN PURGING GAS-HOLDER. *Gas World* (British) 128, 902-903 (1948) *June* 5; *Gas J.* (British) 255, 40-41 (1948) *July* 7.

Dry ice was employed to purge a 4.5 Mcf gas holder because of the excessive cost of hiring a purging machine in an outlying district. Procedures and recommendations for this type of operation are discussed.

E. F. Davis

Reforming of Hydrocarbons

Carroll, J. W. REVIEW OF REFORMING OF HYDROCARBONS IN WATER GAS SETS. PART I—REFORMING OF REFINERY OIL GAS, LIQUEFIED PETROLEUM GAS AND GAS OIL. Paper presented at the 1948 A.G.A. Joint Production and Chemical Committee Conference at Asbury Park, New Jersey, May 24-26, 1948.

"Reforming" is used to refer to the reaction of hydrocarbon with steam under elevated temperature. The reforming of refinery oil gas, liquefied petroleum gas and gas oil in six nine-foot internal diameter U.G.I. mechanical generators at Chester is described in detail. The flexibility of the method and its utility in a mixed gas system are emphasized.

C. H. Riesz

Paquette, R. B. REVIEW OF REFORMING OF HYDROCARBONS IN WATER GAS SETS. PART II—REFORMING OF NATURAL GAS. Paper presented at the 1948 A.G.A. Joint Production and Chemical Committee Conference at Asbury Park, New Jersey, May 24-26, 1948.

Natural gas is being reformed in nine-foot internal diameter machines in the Crawford Station. As in the work at Chester, the presence of lampblack may be observed by impingement of a gas stream on a piece of filter paper. It is customary to use a few gallons of oil in the carburetter to reduce the viscosity of the tar produced.

C. H. Riesz

Underground Gasification

THE UNDERGROUND GASIFICATION OF COAL. *Gas Research Board Information Circular No. 2* (British) *April,* 1946.

A survey of the literature available on underground gasification is made; the main conclusions are (1) although a 320 Btu gas is theoretically possible by using oxygen, practice indicates approximately a 150 Btu gas with the use of oxygen and a 100 Btu gas with the use of air, (2) the gas produced is generally not suitable for domestic purposes, (3) underground gasification was applied to advantage in steeply sloping coal seams, (4) evidence as to gasification efficiency is lacking, but it is believed that large quantities of coked coal residues remain untouched, the gas consisting of large proportions of the products of coal distillation, and (5) substantial savings in labor and capital expenditure are possible, as compared to normal gasification methods. Early methods of underground gasification and later developments such as the "borehole-producer", "stream" method, and percolation, are traced. References are cited.

C. Von Fredersdorff

Western Coals

Parry, V. F. RESUME OF BUREAU OF MINES RESEARCH AND DEVELOPMENT WORK ON WESTERN COALS. *U. S. Bureau Mines Report of Investigation 4171* (1948) *January.*

With the principle objective of making available suitable raw materials for western steel production during the war years, the following investigations were undertaken: (1) determination of location and reserve estimates of western coal beds, (2) determination of the carbonizing properties of western coals both by test and by an empirical correlation, (3) storage of coal in such a way as to eliminate spontaneous combustion, (4) drying low rank coals by steam, and (5) combustion of low rank coals in a specially designed heater. Other developments include work on the complete gasification of coal and lignite, disposal of char and coal dust by reaction in a suspension system and testing of briquettes made from western coals.

C. Von Fredersdorff

5. NATURAL GAS AND NATURAL GAS CONDENSATES

Booster Station

Mueller, A. V. COOLING WATER FOR GAS BOOSTER STATIONS. *Petroleum Engr.* (Ref. Annual) **19**, 202, 204, 206 (1948) *July* 1.

See *Gas Abstracts* **4**, 29 (1948) *February* for abstract.

Compression-Dehydration Plant

Weber, G. COMPRESSION, DEHYDRATION PLANT PROVIDES FULL GAS UTILIZATION. *Oil Gas J.* **47**, 63, 70 (1948) *July* 1.

About 7MMcf/day of low pressure casinghead gas and about 10MMcf/day of high pressure gas is processed in a compression-dehydration plant. The plant is connected to 64 oil wells nearly all of which are on gas left by a nine mile gathering system and to high pressure gas wells by a four and one half mile gathering system. After compression and scrubbing the casinghead gas is mixed with the prime gas from an inlet separator and sent to the dehydrators. Dehydration to not more than seven lbs. of water per MMcf is accomplished with granular dessicant. The drying agent has been regenerated by hot gas on alternate days for two and one half years without loss of activity. Both gas streams treated are very lean (about one half gallon of liquids per Mcf) so that an absorption plant would not be economical. Liquids are recovered at the separators, between stages of compression and from the dehydration system.

J. D. Parent

Condensate Production and Cycling

Jones, P. J. CONDENSATE PRODUCTION AND CYCLING — PART 18 — WATER INJECTION INTO A STRATIGRAPHIC TRAP. *World Oil* **128**, 162, 166, 169 (1948) *July.*

A pressure maintenance program is laid out for a stratigraphic trap type of condensate reservoir. Data are given to indicate the optimum production rate.

J. D. Parent

Distribution

Miller, D. J. DENVER DISTRIBUTION DESIGN FOR HOUSEHEATING LOAD. Paper presented at the 1948 Distribution, Motor Vehicle and Corrosion Conference at Pittsburgh, Pa., April 19-21, 1948.

A discussion of the reasoning in the design of Denver distribution system, which is patterned after the "Doherty Ideal Distribution System" is given. Miscellaneous data and sketches of the system are shown.

E. F. Davis

Gas-Conservation Project

Weber, G. HUGE GAS-CONSERVATION PROJECT NOW IN INITIAL OPERATION STAGE. *Oil Gas J.* **47**, 60-61 (1948) *July* 8.

Total utilization of casinghead gas is now being utilized in the Seeligson field of southwest Texas under a unit program involving, at present, a large part of the field. The plan has proceeded to the point where gathering and compressing gas for pipe line use is being practiced. A 14

RVP compression product is currently being recovered. Within one year it is planned to operate a complete cycling plant. Large quantities of liquid products will then be made available.

J. D. Parent

Gas Injection Project

Barnes, K. B. NORTH COWDEN WEST TEXAS' 1ST HIGH-PRESSURE GAS INJECTION PROJECT ON COOPERATIVE AND POOL-WIDE BASIS. *Oil Gas J.* 47, 52-55, 119 (1948) *July* 1.

A twenty year gas injection program has been formulated on a pool-wide basis for the North Cowden field in West Texas. 30 operators and 27,000 acres are involved.

J. D. Parent

Gas Purification

Anderson, R. B. SEPARATION OF GASEOUS MIXTURES. U. S. 2,437,288 (1948) March 9.

This is a process for accomplishing the simultaneous removal of hydrocarbons and one or all of the acidic constituents, and water from natural gas in a simple, cyclic absorption plant. The gas is scrubbed countercurrently with an absorbent which consists of two immiscible liquids. The spent absorbent may be regenerated either in a single or in two separate regenerating towers. The latter method, however, is preferable for two reasons: (1) to keep the recovered natural gasoline from contamination with the acidic constituents, (2) to prevent emulsification of two immiscible liquids due to high turbulence.

H. L. Hsu

Chapin, W. F. and Blohm, C. L. PURIFICATION AND DEHYDRATION OF GASES. *Calif. Oil World* 41, 3, 5-7, 9-10, 12-13, 15, 17 (1948) *June.*

The subject of removal of H_2S, CO_2 and water vapor from gas is treated particularly with respect to usage of aqueous monoethanolamine and aqueous glycol-amine solutions. Flow sheets, some engineering data and limited cost data are given. It is stated that a plant treating 50MMcf/day of sour gas containing 2% acidic material costs $300,000 and that if amortization is realized in 5 yrs. the cost of purification and dehydration is 5½ to 6 mils per Mcf.

J. D. Parent

McCartney, E. R. GAS PURIFICATION AND DEHYDRATION PROCESS. U. S. 2,435,089 (1948) January 27.

The invention deals with the process of treating a gaseous mixture for the removal of moisture and an acidic constituent with the glycol and amine absorbents in a single contactor which has two sections. The process has among its major objects the recovery of volatile amine; regeneration of the spent absorbents for reuse; reduction in the size of equipment; and reduction in operating costs through lowering the circulation rates. A flow sheet of the process is presented.

H. L. Hsu

LP-Gas Bulk Plants

WHAT IS A TYPICAL BULK PLANT? *LP-Gas* 8, 53-54, 98-99 (1948) *June.*

A survey was made of the LP-gas bulk plant operations covering the following points: storage capacity, dealer organizations, available services (cylinder, tank or both), appliance selling, installation, and truck operation. The results of this survey are reported.

E. F. Davis

LP-Gas Utilization

Jamison, E. A. THE USE OF PROPANE AND BUTANE GASES. *Ind. Heating* 15, 948, 950, 952, 954, 956, 958 (1948) *June.*

A comparison of LP-gases with other types of fuel for use in enameling plants is given.

E. F. Davis

Natural Gas Compressibility

Eilerts, C. K., Carlson, H. A. and Mullens, N. B. EFFECT OF ADDED NITROGEN ON COMPRESSIBILITY OF NATURAL GAS. PART 2. *World Oil* 128, 144-146, 149-150, 152, 154, 157-158, 160 (1948) *July.*

Nitrogen was mixed with a natural gas in different proportions and compressibility data were measured. The additive compressibility factor method of Kay based on pseudo-critical constants was found to lead to answers somewhat in error. A more correct method of predicting compressibility factors for nitrogen-natural gas mixtures is suggested based on experimental correction factors.

J. D. Parent

Natural Gas Utilization

Bludworth, J. E. CHEMICALS FROM PETROLEUM. *Petroleum Engr.* (Ref. Annual No.) 19, 146, 148, 150, 152, 154 (1948) *July* 1.

See *Gas Abstracts* 3, 78 (1947) *May* for abstract.

Operating Problems

Potter, L. T. OPERATING PROBLEMS OF THE INDEPENDENT GAS PRODUCER. *World Oil* 128, 44, 46, 48 (1948) *June.*

The various problems which today confront the independent gas producer are discussed relative to their effect upon present and future operations. The pros and cons of utilization in the development and operation of producing fields, gas proration, the disposal of casinghead gas, possible establishment of a common pressure base for measuring gas, the relationship of the independent gas producer with other phases of the gas and petroleum industries, and the possibility that producers may encounter increased government regulation are among the topics covered.

J. C. Lane

Secondary Recovery

Carter, D. V. THE FORMATION AND OPERATION OF COOPERATIVE PROJECTS IN SECONDARY RECOVERY. *Petroleum Engr.* (Ref. Annual No.) 19, 126-128, 130, 132, 134 (1948).

Reasons for cooperation in the operation of a common reservoir by several operators are presented.

J. D. Parent

6. PETROLEUM AND SYNTHETIC LIQUID FUELS

Dehydrogenation Process

Hachmuth, K. and Hanson, G. H. BUTANE DEHYDROGENATION PILOT PLANT INVESTIGATIONS. *Chem. Eng. Progress* 44, 421-430 (1948) *June.*

Results are presented of an extended pilot plant investigation by the Phillips Petroleum Company on the catalytic dehydrogenation of normal butane to normal butylenes. Chromia-alumina catalyst was used in alloy reactor tubes at tube wall temperatures mainly in the range of 1000 to 1150°F. Catalyst tubes of 27% chromium steel (type 446) and copper gave satisfactory performance; 18% chromium-8% nickel (type 304), 12 and 18% chromium (types 410 and 430) produced excessive cracking due to a dusting of metal or metal oxides coated on the catalyst. Water in the feed reduced catalyst activity, the poisoning effect being more noticeable at lower temperatures. High steam concentrations in the regenerating gases also produced deleterious effects. Other operating variables are discussed as well as the results of spectrophotometric analysis of the C_4 fractions.

C. H. Riesz

Hanson, G. H. and Harp, H. L. PHILLIPS BUTANE DEHYDROGENATION PROCESS. *Chem. Eng. Progress* 44, 431-442 (1948) *June.*

Various features of a plant operating since 1943 for the catalytic dehydrogenation of butane to butylenes are described. Catalyst reactors are arranged in rows of 16 tubes each, every two rows being connected at top and bottom to common headers at top and bottom to form a "harp". Internal diameter of the tubes is 2 inches and length is 10 ft. Tube material is 27% chromium steel (type 446). Isothermal temperature conditions are attained by flue gas recirculation. Special plant tests relative to space velocity, catalyst age, temperature, feed composition and materials of construction are presented. Following frequent breakage of the 27% chromium "harps", evaluation of other alloys led to the conclusion that 25-20 alloy (type 310) and 18-8 Si (type 302-B) equalled the performance of 27% chromium and were mechanically more stable. Replacement harps now contain 25-20 tubes and 18-8 Si headers.

C. H. Riesz

High Octane Gasoline

Kimball, F. B. and Scott, J. A. REFINERY TOOLS FOR PRODUCING HIGH OCTANE GASOLINE. *Petroleum Refiner* 27, 116-123 (1948) *June.*

Six cases are presented showing yields and qualities of products obtained from various processing arrangements, which include various combinations of thermal cracking, thermal reforming, Polyforming, and catalytic cracking by TCC and Fluid methods. Of special interest is a table showing a detailed breakdown of costs of operation of a thermal cracking unit, and of Fluid, TCC, and Houdry catalytic cracking units.

W. J. Merwin

Hydrocarbon Conversion

Kelso, E. A. and Synder, J. A. HYDROCARBON CONVERSION AT HIGH TEMPERATURES AND PRESSURE. *Ind. Eng. Chem.* 40, 1332-1336 (1948) *July.*

A very detailed description is given of a pilot plant for studying a petroleum refining process which operates at pressures up to 1500 psi and at temperatures up to 1500°F. The specific items covered are the charge system, heater coils and lead baths, soaking drum, tar pot, stabilizing

column, reactor and auxiliaries. The operating procedures and curves showing typical results obtained are shown.

W. J. Merwin

Mercaptan Removal

REGENERATION STEPS CUT COST OF REMOVING MERCAPTANS. *Petroleum Processing* 3, 435-438 (1948) *May.*

Application of the tannic acid sweetening process for mercaptan removal from a wide variety of hydrocarbon fractions is discussed. The advantages of regeneration of treating solutions by air blowing in the presence of catalysts are pointed out and a study of the variables affecting regeneration rates obtained by this procedure is presented. A flow diagram of the process is given along with plant scale data on treatment of motor gasoline and butane feed stock for an alkylation unit.

H. Hakewill

Petrochemical Industry

PHENOMENAL EXPANSION CONTINUING IN THE PETROCHEMICAL INDUSTRY. *Oil Gas J.* 47, 237-238, 240-244 (1948) *June* 24.

The Gulf Coast will possess approximately 85% of the nation's capacity to produce chemicals from petroleum hydrocarbons when facilities now planned are completed. Plant investment in this area, to date, for such facilities is estimated as 500-750 million dollars, depending upon the precise definition of a petrochemical plant. Established chemical-manufacturing companies account for most of the investment, but petroleum companies with large refining and research organizations are becoming increasingly active. Besides a diversity and abundance of the necessary raw materials, largely waste refinery gases, the Gulf Coast area offers ample low-cost fuel in the form of natural gas and the advantage of deep-water transportation.

J. C. Lane

Abstractor's Note: Of particular interest to the gas industry are those plants which utilize natural gas or its components as chemical raw materials. Notable among these are: the hydrocarbon-synthesis plant being constructed at Brownsville, Texas, to convert some 64,000,000 cu ft of natural gas per day into gasoline, oil fuels, and organic chemicals; Celanese Corporation of America's plant for the oxidation of butane and propane to a long line of organic chemicals, consuming some 5½ to 6 million gallons of these liquefied gases monthly as raw material and about 32,000,000 cu ft of natural gas daily as fuel; DuPont's nylon salt plant which obtains both its necessary hydrogen and ammonia from natural gas; and McCarthy Chemical Company's new $15,000,000 plant for producing formaldehyde, methanol, acetaldehyde, and other synthetic organic chemicals by oxidation of natural gas. There is no doubt that the availability of cheap natural gas both for fuel and raw material is a strong factor in the chemical industry's development in the Gulf Coast area.

Solidification of Organic Liquids

Shackleton, L. R. B. THE FUEL RESEARCH STATION EMULSION PROCESS FOR THE SOLIDIFICATION OF ORGANIC LIQUIDS. *Fuel* (British) *n.s.* 27, 19-25 (1948) *April.*

Petroleum oils are "solidified" by forming an oil in water emulsion with an aqueous solution or suspension of synthetic resin, which will set to a solid on standing. The oil content is 95%, the urea-formaldehyde content is 2.5% and the balance is water. The solid has a specific gravity of 0.75, can be stored underwater and will not catch fire when hit with tracer bullets. About 90% of the oil can be recovered by subjecting the solid to mechanical pressure. Directions are given for preparing the solidified oil on a laboratory and an industrial scale. The process was developed during the war in order to minimize fire hazards as a result of air attacks.

W. J. Merwin

7. ANALYTICAL METHODS AND TESTS

Acetylene Determination

Shaw, J. A. and Fisher, E. DETERMINATION OF ACETYLENE IN GAS. *Anal. Chem.* 20, 533-536 (1948) *June.*

A method is described for determining acetylene in gas by scrubbing the gas with a strong solution of silver nitrate and then precipitating and weighing the acetylene complex as $Ag_2C_2 \cdot AgNO_3$. The procedure provides for quantitatively removing the acetylene from a flowing gas stream, avoiding the reducing effect of hydrogen upon silver nitrate, and describes a technique for largely avoiding explosion hazards to the operator. As the size of sample is substantially unlimited, the method can be used for determining very low concentrations of acetylene. The accuracy of the method appears to be limited by the mechanical considerations involved in gravimetric procedure.

Authors' abstract

Carbon Monoxide Detection

Berkebile, J. M. TESTING FOR CARBON MONOXIDE. *J. Chem. Ed.* 25, 342-343 (1948) *June.*

Both qualitative and quantitative chemical methods for detecting carbon monoxide are described. Accuracy of these tests is evaluated. Some physiological data is given and a prediction is made for possible blood saturation for various concentrations of the gas in air. Two economical and simple "detectors" are described in detail.

E. M. Rueck

Gas Analysis Apparatus

Crouthamel, C. E. and Diehl, H. GAS ANALYSIS APPARATUS EMPLOYING THE VELOCITY OF SOUND. *Anal. Chem.* 20, 515-520 (1948) *June.*

The composition of certain binary gas mixtures can be determined by measuring the velocity of sound in the gas. An audio-frequency oscillator (1000 to 3000 cycles per second) is used to generate a small dynamic speaker placed at one end of a brass tube through which the gas sample flows. A sensitive microphone at the opposite end of the tube gives a maximum or minimum signal, depending upon the resonance conditions of the tube, which depend on the length of the tube and the values of the density and the specific heats of the components of the mixture. For a given tube length and sound frequency, the intensity of the microphone signal is a trigonometric function of the composition of the mixture. The microphone signal is amplified electronically and registered on a meter that can be calibrated in terms of the composition of the gas mixture and gives a continuous reading of the composition of gas flowing through the tube. The device has been applied to analysis of mixtures of hydrogen in air, full scale representing 10% hydrogen, in any range between 0 and 100%. The electronic circuit provides an electrical signal when one component of the mixture exceeds a preset value. The apparatus has been used for analysis of methane-air and carbon dioxide-air mixtures.

Authors' abstract

Gas Composition Measurement

Ackley, R. A. METHOD OF AND APPARATUS FOR MEASURING THE COMPOSITION OF GAS. U.S. 2,437,720 (1948) March 16.

Claims are made for a thermoelectric device which upon immersion in a flame will record per cent oxygen. Claim is said to be based on the fact per cent oxygen in a mixture is directly proportional to the flame temperature.

E. F. Davis

Microdetermination of Sulfur

Steyermark, A., Bass, E. and Littman, B. MICRODETERMINATION OF SULFUR IN ORGANIC COMPOUNDS. *Anal. Chem.* **20,** 587 (1948) *June.*

Improvements in the microdetermination of sulfur in organic compounds are described. Among these are: (1) substitution of the Carius combustion method for the catalytic or Grote procedures, and (2) titration of sulfate with barium chloride using tetrahydroxyquinone indicator in conjunction with an illuminated titration stand technique. Details for carrying out analyses by this improved procedure are given along with results obtained with it for known samples.

H. Hakewill

Moisture in Coal

Bainbridge, J. R., Eisenklam, P. and Scanlan, P. G. THE MOISTURE CONTENT OF BROWN COAL BY DISTILLATION. *Fuel* (British) **26,** 150-153 (1947) *November-December.*

Experiences in determining the moisture in coals having moisture contents from 36% to 68% by a distillation method, are recorded. The apparatus used is that described in British Standard Specification 1016-1942. The statistical analysis of the results led to the following conclusions. The standard error of a single determination is about 0.36%. The quantity of distillate used is based upon the quantity of water to be removed from the coal sample. Variation in the distillate quantity does not affect the accuracy of the result, but insufficient distillate, particularly with lower moisture coals, gives a very unsatisfactory end point to the distillation. Care should be taken to prevent moisture loss from the condenser top. The time required for a distillation is approximately $\frac{8 \times \%\text{ moisture as received}}{100} + 1\frac{1}{2}$ hours.

M. C. Miyaji

Organic Sulfur Determination

Brady, L. J. DETERMINATION OF THIOPHENE, CARBON OXYSULFIDE, AND CARBON DISULFIDE IN PRODUCER GAS. *Anal. Chem.* **20,** 512-514 (1948) *June.*

A spectrophotometric method for the quantitative determination of thiophene, carbon oxysulfide, and carbon disulfide in producer gas is described. Concentrations of these sulfur compounds, absorbed from the gas by means of a piperidine-ethanol scrubbing solution, are measured in terms of ultraviolet absorption with a Beckman model DU quartz spectrophotometer. The presence of aromatic hydrocarbons necessitate corrections for C_4H_4S and COS analyses but do not affect CS_2 analysis. Small concentrations of H_2S, mercaptans, and other sulfur compounds do not cause interference. Application of the method is demonstrated by the analysis of one-liter samples of synthetic producer gas containing 250 gr. S as C_4H_4S per 100 ft^3, 0 and 350 gr. S as COS per 100 ft^3, 0 and 460 gr. S as CS_2 per 100 ft^3, and 0 and 1.5% C_6H_6. Deviations for each of the sulfur compounds present in these tests ranged from 33 to 45 gr. S per 100 ft^3.

H. Hakewill

Abstractor's note: It seems unfortunate that the author chose to illustrate the application of this method with analyses of gases containing such high concentrations of organic sulfur. Since it is claimed that the method is effective down to 0.013 gr. S per 100 ft^3, data showing precision at 0-10 gr. S per 100 ft^3 would be most interesting.

Particle Size Determination

Watson, J. H. L. PARTICLE SIZE DETERMINATIONS WITH ELECTRON MICROSCOPES. *Anal. Chem.* **20,** 576-584 (1948) *June.*

Important practical errors inherent in the methods of electron microscopy and how to minimize them, and procedures for securing semiquantitative data from electron micro-

graphs, are discussed in sufficient detail to emphasize factors that have been found from actual experiment most important for accurate, routine counting procedures. If the precautions described are taken and the methods are followed, reproducibility of results within better than 5% is to be expected. High reliance can be placed on the data, and one is justified in using them industrially in process control. An absolute accuracy of much better than 90% is achieved. The precautions are applicable to all fields of electron microscopy and the experimental procedures and statistical methods to any measurement of particle sizes, where the word "particle" is used in the broad sense of "the thing measured for statistical treatment."

Author's abstract

8. GENERAL AND PHYSICAL CHEMISTRY

Dehydration Catalysts

Feachem, G. and Swallow, H. T. S. ALUMINA CATALYSTS FOR VAPOR PHASE ORGANIC DEHYDRATIONS, DEAMINATIONS, ETC. *J. Chem. Soc.* (British) **1948**, 267-272 *(March).*

Activities of various alumina catalysts were studied in the vapor phase dehydration of ethanol to ethylene. It was concluded that gamma alumina is the active form, that high purity (freedom from alkalis) is required and that small crystal sizes produce the most active catalysts. The time to dehydrate boehmite, AlO(OH), to the active gamma alumina varies widely from sample to sample and sufficient care must be exercised to insure that this conversion is complete.

C. H. Riesz

Fischer-Tropsch Catalysts

Ghosh, J. C. and Basak, N. G. CHROMIUM OXIDE AS A CATALYST PROMOTER FOR FISCHER-TROPSCH SYNTHESIS AT MEDIUM PRESSURES. *Petroleum* (British) **11**, 131-132, 146 (1948) *June.*

Synthesis of hydrocarbons from carbon monoxide and hydrogen has been conducted in the presence of (a) cobalt-copper-thoria-ceria-chromia-kieselguhr and (b) cobalt-copper-thoria-ceria-kieselguhr. The use of CO and H_2 in the ratio 1:1 diminished methane formation. Best yields of hydrocarbons were obtained with catalyst (a) at about 75 psig pressure and at temperatures slightly above 400°F. Without chromia as a promoter (catalyst (b)), yields were somewhat lower.

C. H. Riesz

Abstractor's Note: Yields of liquid hydrocarbons were considerably lower than have been reported with cobalt-thoria-kieselguhr catalyst. Thus, the value of copper-ceria or copper-ceria-chromia in promoting catalyst activity for Fischer-Tropsch synthesis has not been demonstrated.

Eischens, R. P. and Selwood, P. W. STRUCTURE AND ACTIVITY OF THE CHROMIUM ALUMINUM OXIDE CATALYST SYSTEM. *J. Am. Chem. Soc.* **70**, 2271-2273 (1948) *June.*

Surface area, magnetic susceptibility and catalytic activity data for chromia-alumina catalysts are correlated. It is concluded that the chromia is not uniformly dispersed over the surface of the catalyst but occurs in small piles. At point "1" of the susceptibility-composition isotherm, only one-ninth of the alumina surface is covered with chromia; the average chromium atom is in a crystallite about three atom layers thick.

C. H. Riesz

Montgomery, C. W. and Weinberger, E. B. PRODUCT DISTRIBUTION IN THE SYNTHESIS OF HYDROCARBONS FROM CARBON MONOXIDE AND HYDROGEN. *J. Chem. Phys.* **16**, 424 (1948) *April.*

Thermodynamic equilibrium among the normal paraffins was found to produce a calculated distribution according to carbon content which is qualitatively similar to that observed experimentally in the synthesis of hydrocarbons from carbon monoxide and hydrogen. Results calculated for 613°F (600°K) agree more closely with experimental data for 374-392°F than do calculated results for 392°F (473°K). This is in accord with the recognized fact that true catalyst temperature in Fischer-Tropsch synthesis is considerably higher than measured temperatures because of the exothermic nature of the reaction.

C. H. Riesz

Tebboth, J. A. THE DECOMPOSITION OF CARBON MONOXIDE BY NICKEL CATALYSTS. THE REACTION MECHANISM BETWEEN 250° AND 450°. *J. Soc. Chem. Ind.* (British) **67**, 62-66 (1948) *February.*

Decomposition of carbon monoxide by nickel catalysts has been studied in the temperature range, 482-842°F. Reduced nickel showed little activity, but upon inclusion of thoria or kieselguhr in a nickel catalyst, a marked increase in the rate of decomposition was observed. At 482°F nickel-thoria-kieselguhr was converted almost quantitatively to nickel carbide, Ni_3C. Above this temperature formation of carbide was incomplete and decomposition of the carbide was demonstrated, this reaction becoming rapid at 572°F. The fraction of carbon combined as carbon decreased with increasing temperature but some remained at 842°F. The work is part of the research program being conducted at the Fuel Research Station in England on the catalytic formation of methane from water gas.

C. H. Riesz

Hydrogenation Catalysts

Pelipetz, M., Kuhn, E. M., Friedman, S. and Storch, H. H. EFFECT OF CATALYSTS ON THE HYDROGENOLYSIS OF COAL. *Ind. Eng. Chem.* **40**, 1259-1264 (1948) *July.*

Elimination of asphaltenes from the primary product of coal hydrogenation is desirable since these materials give rise to heat transfer difficulties. Various catalysts were tested for activity in promoting hydrogenolysis of asphaltenes. Tin, zinc, arsenic and antimony as well as various combinations of these metals were tried. Tin proved to be one of the best catalysts in the primary cracking of coal, zinc-antimony showed activation in the hydrogenolysis of sphaltenes and a combination tin and zinc-antimony catalyst was effective at lower temperatures (752-779°F). The above tests were in the presence of tetralin as a vehicle; tests made in the absence of vehicle gave much lower quantities of asphaltenes.

C. H. Riesz

Iron Carbide Catalysts

Hofer, L. J. E. INTRODUCTION TO THE CARBIDES OF IRON AND THEIR PHYSICAL AND CHEMICAL PROPERTIES. Bureau of Mines, Office of Synthetic Liquid Fuels, Research and Development Branch, Report 3141-Q:88, May 3, 1948, pp. 1-45.

This report constitutes an introduction to the main report by H. Pichler and H. Merkel entitled "Chemical and Thermomagnetic Studies on Iron Catalysts for the Synthesis of Hydrocarbons." It presents a comprehensive, annotated literature review with critical comments on the present day knowledge concerning iron carbides, their types, formation, and properties with special reference to their application to the carbide theory on the production of hydrocarbons by the hydrogenation of CO over iron catalysts. Special consideration is given to the conditions of formation and the identification of two new Fe_2C carbides—the carbides I

and II of Pichler and Merkel, the former having the Curie point at 265° and the latter at 380° identifiable with the hexagonal, close-packed iron carbide of Halle and Herbst. Appendices A-D present the evidence in the form of translations of laboratory memo on the discovery of the Halle and Herbst carbide. Recent investigation at the Bureau of Mines indicates that carbide I is identical with the Hagg carbide.

U. S. Bureau Mines Synthatic Liquid Fuels Abstracts n.s. 1, 4, Item 516 (1948) July.

Absorption Spectra

Thompson, H. W. THE CORRELATION OF VIBRATIONAL ABSORPTION SPECTRA WITH MOLECULAR STUDIES. *J. Chem. Soc.* (British) 1948, 328-331 *(March)*.

The absorption bands associated with the principal vibration frequencies are presented in a series of four charts. A bibliography lists the origin of all data.

S. Katz

Critical Densities of Liquids

Benson, S. W. CRITICAL DENSITIES AND RELATED PROPERTIES OF LIQUIDS. *J. Phys. Colloid Chem.* 52, 1060-1074 (1948) *June.*

The application of the law of corresponding states to liquids is examined. It is found that the reduced density of most liquids is approximately constant at the boiling point. Methods of calculating critical volumes, critical temperatures and coefficients of expansion of liquid from reduced data are described.

S. Katz

Ignition of Gas Mixtures

Viallard, R. IGNITION OF EXPLOSIVE GAS MIXTURES BY ELECTRIC SPARKS. MINIMUM IGNITION ENERGIES. *J. Chem. Phys.* 16, 555 (1948) *May.*

The author disagrees with recently published papers (*J. Chem. Phys.* 15, 798 (1947)) by Lewis, Von Elbe and co-workers in which it is claimed that minimum values exist for the energies of electric sparks which initiate flames in explosive gas mixtures. It is pointed out that other observations show the shape of the electrodes and the applied voltage to be factors. An attempt is made to reconcile the apparent conflicting opinions.

S. Katz

Methane–N-Butane–Water System

McKetta, J. J., Jr. and Katz, D. L. METHANE-n-BUTANE-WATER SYSTEM IN TWO- AND THREE-PHASE REGIONS. *Ind. Eng. Chem.* 40, 853-863 (1948) *May.*

The two- and three-phase regions of the methane-n-butane-water system were determined experimentally at 100°, 160°, 220° and 280°F and at pressures up to 3000 psi. The use of the data to predict the water content of the hydrocarbon phases and the solubility of the gases in water is described. Equilibrium constants relating the concentrations between the phases are also given.

S. Katz

Surface Tension Correlation

Othmer, D. F., Josefowitz, S. and Schmutzler, A. F. CORRELATING SURFACE TENSIONS OF LIQUIDS. *Ind. Eng. Chem.* 40, 886-889 (1948) *May.*

The abstract appearing in *Gas Abstracts* 4, 135 (1948) *July* should have given the correlation of surface tension to temperature as

$$\sigma = \sigma_0(1 - T/Tc)^n.$$

Vapor Pressure of Liquids

Wall, F. T. A THEORY OF VAPOR PRESSURES OF LIQUIDS BASED ON VAN DER WAALS' EQUATION OF STATE. *J. Chem. Phys.* 16, 508-512 (1948) *May.*

Van der Waals' equation of state is used as a starting point to derive expressions for vapor pressures of liquids and heats of vaporization. A very simple generalized or "reduced" vapor pressure equation is also developed, and a calculation of Trouton's constant is presented. The limitations in terms of accuracy of the van der Waals' equation are noted.

S. Katz

9. ORGANIC CHEMISTRY

Acetylene

Hanford, W. E. and Fuller, D. L. ACETYLENE CHEMISTRY. *Ind. Eng. Chem.* 40, 1171-1177 (1948) *June.*

Two general methods have been worked out for handling the hazardous behavior of acetylene under pressure 200-300 pounds per square inches at about 200°C.: (1) diluting the acetylene with inert gases; and (2) filling the free space present in the system with bunches of small tubes or with a packing material. The first method is probably best for autoclave operation, the second method is preferred for continuous operation. Data on the limiting pressures for explosion of mixtures of acetylene with gaseous diluents are graphically presented. Only four types of reactions of acetylene under pressure are discussed: vinylation, ethynylation, carboxylation, and cyclic polymerization. The first three reactions are of importance in the production of synthetic resins. Different catalysts and their preparations used in each reaction are also described.

H. L. Hsu

OXO Synthesis

Wender, I. and Orchin, M. CRITICAL REVIEW OF CHEMISTRY OF OXO SYNTHESIS FOR PRODUCTION OF ALCOHOLS FROM OLEFINS, CARBON MONOXIDE, AND HYDROGEN. U.S. Bureau Mines Report of Investigations 4270 (1948) *June.*

Information contained in various Technical Oil Mission reports pertaining to the German "OXO" process is reviewed critically. Olefins are reacted with carbon monoxide and hydrogen (water gas) in the presence of Fischer-Tropsch or other catalysts to produce mainly aldehydes containing one more carbon atom than the original olefin. Reduction with hydrogen of the aldehydes to primary alcohols takes place in a second stage. Various unsaturated substances (e.g., acetylene, ethylene and ethyl oleate) have been tried but practical application was to olefins derived from Fischer-Tropsch synthetic oils in the boiling range, 356-608°F. Alcohols produced in this manner were converted to sulfate for detergent uses. Sulfur does not hinder the OXO reaction but does poison the hydrogenation step. Various reaction mechanisms have been proposed including cyclopropanone ring intermediate, carbonium ion theory (cobalt hydrocarbonyl catalyst) and free radical mechanism.

C. H. Riesz

Sulfonyl Chloride Preparation

Lockwood, W. H. HYDROCARBON SULFONYLATION. *Chem. Ind.* 62, 760-763 (1948) *May.*

Relatively cheap sulfonyl chlorides are prepared by reacting a saturated aliphatic hydrocarbon

(long or short chain) with a gaseous mixture of sulfur dioxide and chlorine using actinic light as the catalyst. The reaction carried out in a simple manner both in the laboratory and in the plant is described. A number of variables which have an effect on the reaction are discussed. The most important commercial use of this reaction is in the production of surface active agents.

H. L. Hsu

10. CHEMICAL ENGINEERING

Exothermic and Endothermic Discontinuities

Samaras, D. G. GAS DYNAMIC TREATMENT OF EXOTHERMIC AND ENDOTHERMIC DISCONTINUITIES. *Can. J. Research Sec. A* **26**, 1-21 (1948) *January.*

Endothermic and exothermic processes in gas dynamic flows taking place in a very narrow zone may be considered as discontinuities. The variation of the static and total head density ratio, pressure ratio, and temperature ratio as well as the angle of deviation, area ratio, and exit normal Mach number have been found as functions of the entry normal Mach number and of heat addition. In addition to these, some other useful quantities such as the area ratio parameter, the difference of the square of velocities, and the normal velocity product have been evaluated. It was found that, in a discontinuity, heat can be added until the exit normal Mach number reaches unity (choking). Depending on the entry normal Mach number, only a limited amount of heat can be added at the discontinuity. An exothermic discontinuity behaves as an expansion when the entry normal Mach number is subsonic, and it is accompanied by a drop in static pressure, density, and total head pressure. An exothermic discontinuity behaves as a compression shock wave when the entry normal Mach number is supersonic, and it is accompanied by an increase in static pressure and density and a decrease in total head pressure. An endothermic discontinuity behaves always as a compression shock wave, and it is accompanied by an increase in static density, pressure, and total head pressure. It is hoped that the results and conclusions found may be useful in a better understanding of many nearly discontinuous phenomena such as flame fronts, condensation and evaporation fronts, and other similar problems.

Author's abstract

Fractional Distillation and Absorption

Edmister, W. C. HYDROCARBON ABSORPTION AND FRACTIONATION PROCESS DESIGN METHODS. Part 13. *Petroleum Engr.* **19**, 47-54 (1948) *June.*

The essential features of the Lewis and Matheson, Thiele and Geddes and Hummel methods of making multicomponent fractionation calculations are presented.

J. D. Parent

Heat Transfer

Bonilla, C. F. HEAT TRANSFER WITH EXTENDED SURFACE. *Ind. Eng. Chem.* **40**, 1098-1101 (1948) *June.*

The author gives a graph as well as a table of values which allows one to determine the average local heat transfer coefficient of a tube with rectangular fins, when the over-all average coefficient based on the mean temperature difference from the fluid to the base of the fins is known. This eliminates the usual trial and error solution.

W. M. Dow

Brinn, M. S., Friedman, S. J., Gluckert, F. A. and Pigford, M. A. HEAT TRANSFER TO GRANULAR MATERIALS. *Ind. Eng. Chem.* **40**, 1050-1061 (1948) *June.*

The operation studied was that of settled Ottawa and ilmenite sands moving downward through vertical tubes. In many cases of heating or cooling of solids it is desirable to keep the solids physically separated from the heating or cooling medium. No data is available in the literature for predicting heat transfer coefficients for the above type of system. Assuming rodlike flow, theoretical predictions of heat transfer were made and compared with experimental results. The former check the data within ±15%. Rodlike flow was demonstrated visually. Design charts have been developed and examples illustrating their use are presented. The charts show either $(T_2 - t_2)/(T_2 - t_1)$ as ordinate versus reciprocal of the Groetz number as abscissa or $(t_2 - t_1)/(T_2 - t_1)$ vs. the Groetz number with surface resistance as a parameter. The surface resistance is equal to the sand thermal conductivity divided by the product of the overall heat transfer coefficient and the tube radius. t refers to the solids temperature and T to the heating or cooling fluid.

C. L. Tsaros

Comings, E. W., Clapp, J. T. and Taylor, J. F. AIR TURBULENCE AND TRANSFER PROCESSES. *Ind. Eng. Chem.* **40**, 1076-1082 (1948) *June.*

The turbulence level, as measured by a hot wire wake angle thermal diffusion device, of an air stream flowing through a duct was varied from 1 to 20% by placing one of several different grid type turbulence generators in the stream. The heat and mass transfer rates from a cylinder, which was normal to the direction of air flame, were measured experimentally and compared with the turbulence level. It was found that the transfer rates were increased by increased turbulence at larger Reynolds numbers, but this effect was negligible at smaller Reynolds numbers. The experimental heat transfer data were correlated to give an equation relating the Nusselt number, the Reynolds number and the turbulence level within the Reynolds number range from 400 to 20,000.

W. M. Dow

Deitz, V. R. and Robinson, H. C. HEAT TRANSFER INTO CYLINDRICAL COLUMNS OF BONE CHAR. *Ind. Eng. Chem.* **40**, 1070-1075 (1948) *June.*

Mathematical expressions have been theoretically derived to describe the heating of bone char in cylindrical retorts. Based on the assumption of rodlike flow, two dimensionless curves have been derived relating the heating time and the throughput to the ratio of the difference in final axial and initial temperatures to the difference in wall temperature and initial temperature, assuming a constant wall temperature. Good agreement was obtained with experimental results. Heat transfer for constant throughput is independent of tube diameter if the wall temperature remains constant. Rodlike flow is more closely realized in large tubes than in small. A three inch tube was used in the experimental work.

C. L. Tsaros

Dunn, W. E., Jr. and Bonilla, C. F. HEAT TRANSFER WITH EXTENDED SURFACE. *Ind. Eng. Chem.* **40**, 1101-1104 (1948) *June.*

Temperature and heat loss equations are derived for the case of heat transfer from rectangular fins to a fluid when no mixing occurs in the fluid in the direction parallel to the fins and perpendicular to the flow of fluid. These equations are then compared with already known equations for the case when complete mixing takes place in this direction. All actual cases would, except for noncompliance with limiting assumptions that have been made in the derivations, fall between these two cases, depending on the amount of heat transfer by eddy and molecular conduction perpendicular to the fluid flow and parallel to the fins.

W. M. Dow

Lof, G. O. G. and Hawley, R. W. UNSTEADY-STATE HEAT TRANSFER BETWEEN AIR AND LOOSE SOLIDS. *Ind. Eng. Chem.* **40**, 1061-1070 (1948) *June.*

Data are presented on unsteady-state heat transfer coefficients from air to loosely packed gravel beds ranging from 4 mesh to 1.5 in.

particle size; entering air rates 12 to 66 std. cu ft per min per sq ft cross section; entering air temperatures 100 to 250°F. Using methods requiring knowledge of inlet and exit conditions only, overall heat transfer coefficients were calculated and were correlated by the simple equation $h = 0.79\ (G/D)^{0.7}$ where h denotes the heat transfer coefficient at a given point in the bed at a given time Btu/hr cu ft °F; G, the mass rate of air flow lb/hr sq ft; and D, the equivalent spherical diameter of particles, ft. The data do not cover a range sufficient to indicate an effect of temperature on the heat transfer coefficient.

C. Von Fredersdorff

Lund, G. and Dodge, B. F. FRÄNKL REGENERATOR PACKINGS. *Ind. Eng. Chem.* 40, 1019-1032 (1948) *June.*

Over-all heat transfer coefficients and friction factors were determined experimentally for air flowing through Fränkl regenerator packings at pressure and temperature conditions in the range encountered in air separation plants. The heat transfer process occurring in the regenerator was of an unsteady nature, the temperatures of the fluid and the solid at any interior point varied with time during a cycle. The experimental results were correlated by means of an over-all heat transfer coefficient derived by analogy to the recuperative-type heat exchanger. Integral averages of the terminal gas temperatures for each period were used to determine the log mean temperature difference, Δt_m, in the usual over-all heat transfer equation: $q = UA\Delta t_m$. The overall heat transfer coefficient was then related to the length to diameter ratio of the packing, the storage factor and the Reynolds number by a correlation of the experimental data. The Fanning equation was used to determine the friction factor which was correlated with the Reynolds number.

W. M. Dow

Abstractor's Note: The friction factor-Reynolds number correlation indicates that the conditions covered in this investigation extended over a transition range between viscous and turbulent flow. This may account for the fact that their correlation shows the film coefficient of heat transfer as a function of the Reynolds number to approximately the 1.5 power instead of the usual 0.8 power for turbulent flow. In any event it would appear to be unwise to apply this correlation outside of their Reynolds number range.

Sinnott, M. J. and Siebert, C. A. HEAT TRANSFER IN A RECIRCULATING FURNACE. *Ind. Eng. Chem.* 40, 1039-1044 (1948) *June.*

The heating of steel in a recirculating air furnace from room temperature to 600°, 800°, 1000°, and 1200°F. has been studied and the effect of air temperature and air velocity on the rate of heat transfer has been investigated. The value of h_c, the instantaneous convective heat transfer coefficient, has been found to be independent of the temperature difference between the metal and the air for a given constant air temperature. The values of h_c for various air temperatures and air velocities have been computed; these values when used with h_r, the instantaneous radiation coefficient of heat transfer, make possible the calculation of the length of time required to heat a metal in a recirculating air furnace to any given temperature.

Authors' abstract

High Vacuum Techniques

Dushman, S. DEVELOPMENT OF HIGH VACUUM TECHNIQUES. *Ind. Eng. Chem.* 40, 778-780 (1948) *May.*

The historical origins of high vacuum techniques are summarized briefly and its influence on modern science and technology is discussed. A number of the formulae governing the behavior of gases at low pressures are presented.

S. Katz

Measurement of Low Pressures

Mellen, G. L. NEW TECHNIQUES IN THE MEASUREMENT OF PRESSURES BELOW 10 MM. *Ind. Eng. Chem.* 40, 787-791 (1948) *May.*

A number of conventional types of pressure gages for work in the vacuum region are described and their limitations are indicated. A new type of ionization gage using a radium ion source is described for use in the region between 0.01 and about 25 mm Hg pressure.

S. Katz

Thermodynamics

Edmister, W. C. APPLICATIONS OF THERMODYNAMICS TO HYDROCARBON PROCESSING. Part X. *Petroleum Refiner* 27, 134-142 (1948) *April.*

Much of the thermodynamics developed for pure substances may be applied to mixtures by the use of the so-called "pseudo-critical" concept. Empirical constants may be derived for mixtures which correspond to the critical constants of pure substances. Rules are given for the derivation of these quantities, by means of calculations from equations of state, by graphical means and by estimating from the mol fractions of the constituents.

S. Katz

Edmister, W. C. APPLICATIONS OF THERMODYNAMICS TO HYDROCARBON PROCESSING. Part XI. *Petroleum Refiner* 27, 93-100 (1948) *May.*

In the present installment of the series a number of thermodynamic properties of fluids are derived in terms of the compressibility factor ($Z = PV/RT$) and the volume residual ($a = RT/P - V$). Formulae are developed first in terms of ordinary P-V-T relations finally in reduced forms.

S. Katz

11. PROCESS EQUIPMENT AND INSTRUMENTATION

Continuous Fractionation Columns

Hills, C. W., Jr. CONTROL OF CONTINUOUS FRACTIONATION COLUMNS. *Can. Chem. Process Ind.* 32, 536-540 (1948) *June.*

Constancy of product composition from a continuous fractionating column is usually indicated by constancy of temperature at some point of the column. In order to obtain constant temperature the feed rate, overhead withdrawal rate, bottoms withdrawal rate, and the rate of heat supply must be constant. Fluctuations in feed rate are minimized by the use of surge tanks or averaging type level controllers. Overhead product rates may be controlled by temperature controllers or combinations of flow, level, and ratio-flow controllers. Bottoms product rates are controlled by level or flow instruments or both. Heat supply to the column may be controlled by a temperature controller acting on a valve in the steam inlet line, or by a level controller which regulates the height of condensate in the reboiler. For a constant steam supply to the reboiler, changing the reflux rate will change the effective heat input. When conditions preclude the use of temperature instruments to control heat input, it is possible to use a ratio flow controller on the feed rate and the steam rate. Six flow diagrams are given showing various methods of control.

W. J. Merwin

Instrumentation in Gasworks

Griffin, R. W. INSTRUMENTATION IN GASWORKS AND COKE OVENS. *Coke & Gas (British)* 10, 180-184 (1948) *May.*

The importance of instrumental control in the gas works and coke ovens is stressed in this

article. Instruments which indicate, transmit, and record the measurements and which have electrical transmitting and recording mechanisms are preferred by the author. Various measurements are recommended for the control of producers, gas retorts, water gas plants, boilers, and gas cleaning and distribution systems. The advantages of a central control panel are emphasized.

B. E. Hunt

12. MATERIALS OF CONSTRUCTION

Alloys for Corrosion Services

Luce, W. A. CAST NICKEL-MOLYBDENUM AND NICKEL-MOLYBDENUM-CHROMIUM ALLOYS FOR SEVERE CORROSION SERVICES. *Chem. Eng. Progress* 44, 453-458 (1948) *June.*

Studies on Chlorimet 2, a nickel molybdenum alloy and Chlorimet 3, a nickel molybdenum chromium alloy revealed that they are resistant to many corrosive chemicals in solution; the former is preferred in a reducing atmosphere while the latter is preferred in an oxidizing solution. In a hot dilute sulfuric acid solution, the Chlorimet 3 is preferred over Chlorimet 2 while the reverse is true for hot intermediate concentrated solutions. By quench annealing at temperatures above 2050°F the services of these alloys may be increased further.

S. Mori

Pipe Corrosion Mitigation

Cramer, A. H. PIPE CORROSION MITIGATION PRACTICES. Paper presented at the 1948 Distribution, Motor Vehicle and Corrosion Conference at Pittsburgh, Pa., April 19-21 1948.

Pipelines to be insulated are thoroughly cleaned with a cutter and a wire brush. Any pits on the pipes are filled with a welding material. The pipe is coated with a layer of wax; then it is machine wrapped with some low dielectric constant material, a second layer of wax is applied over this, and finally a layer of kraft paper is machine wrapped on the pipe. Unprotected spots are checked using an electronic holiday detector before lowering the pipes into the trench. Any damage on the coating during installation of the pipeline can be detected even after burial by using a coating fault locator. The greater portion of failures, about 73%, appears to be due to incorrect handling of pipe during installation.

S. Mori

Plastic Pipe Line Coating

Laulhere, B. M., Jr. PLASTIC PIPE LINE COATING AND YARD PROCESSING. *Petroleum Engr.* 19, 104, 106 (1948) *June.*

Up to the present, the use of plastic coated pipelines was limited because of difficulties in application; however a new process has been developed where a thermoplastic material is fed into a steam of hot air blast leaving a leak proof coating that is resistant to abrasion. Laboratory tests using a salt crack showed this method to be promising.

S. Mori

Turnarounds

Foster, A. L. PREPLANNING TURNAROUNDS, USE OF ALLOYS SHORTEN DOWNTIME, EXTEND ONSTREAM PERIODS FOR OPERATING DISTILLATION EQUIPMENT. *Oil Gas J.* 47, 72-73, 76 (1948) *July* 1.

Various details of preplanning to take care of work during shutdowns are mentioned. By means of systematic planning the shutdown time was reduced from 3 weeks to 6 days at a refinery at Bayway, N.J. Alloy steels are frequently used to reduce the number of shutdowns required. The types of alloy steels for various services are mentioned.

W. J. Merwin

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